Homework 3
Due at the beginning of class Jan. 29

1. A particle at rest is released from the origin in the following field configuration: a uniform $\vec{E}$ points in the z direction while a uniform $\vec{B}$ points in the x direction. Derive an expression for its trajectory.

2. A phonograph record of radius R has a uniform surface charge density σ. It rotates at angular frequency ω in a region with $\vec{B}(x, y, z)$. Derive an integral expression (with limits) for the net force on the record.

3. Constant current I flows along a wire in the shape of a parabola in the x-z plane. The equation determining this shape is $z = x^2$. Derive an expression for the magnetic field from a segment of the wire going from $x = 0$ to $x = L$ at an arbitrary point.

4. Check Stoke's theorem using the function $\vec{F} = ay\hat{x} + bx\hat{y}$ along the circular path of radius R centered at the origin in the xy plane.

5. Shadowitz section 1-5 problem 6.

6. Derive the expression for $\nabla \times \hat{\Re}/|\vec{\Re}|^2$ for $\vec{\Re} \neq 0$, and $\vec{\Re} = \vec{r} - \vec{r'}$ with $\vec{r}$ locating an arbitrary field point for the source current at $\vec{r'}$. Use cartesian coordinates.

7. Derive the force on an equalateral triangle of side a carrying current I_0 which has one side parallel to an infinite wire carrying current I_0 but a distance D away from the wire.

8. (a) In four sentences or less describe how the fundamental theorem of curls is related to the fundamental theorem of calculus. (b) In four sentences or less give a geometrical interpretation of the fundamental theorem of curls.